CLAIMS

1. A method of operating a magnetic resonance apparatus in which magnetic gradient coils are used to generate one or more magnetic field gradients in a working volume so as to define regions from which magnetic resonance signals are obtained in use from a target material; characterised in that, for each of the defined regions, the one or more magnetic field gradients are controlled in accordance with the position of the said region with respect to the gradient coils, so as to apply one or more magnetic field gradients of predetermined uniformity within the region.

2. A method according to claim 1, wherein a set of at least two magnetic gradient coils are provided for producing the magnetic field gradient in a particular direction and wherein the method comprises controlling the ampere-turns values within the at least two coils of the set independently.

3. A method according to claim 1 or claim 2, wherein the defined regions are arranged as a series of regions, such the combined volume of the regions substantially intersects a target volume of the target material.

4. A method according to claim 3, wherein the one or more magnetic field gradients applied to a particular region are dissimilar to those applied to an adjacent region.

5. A method according to claim 3 or claim 4, wherein the magnetic field gradient uniformity within regions at the periphery of the working volume is thereby increased so as to allow improved magnetic resonance signals to be obtained from such regions.

6. A method according to any of the preceding claims, wherein the working volume is arranged to one side of the coils comprising the magnetic resonance apparatus, and wherein the regions are arranged in the working volume.

7. A method according to any of the preceding claims, wherein each region comprises a substantially planar slice.

8. A method according to any of the preceding claims, wherein the method further comprises, within a particular region, controlling the one or more magnetic field gradients in accordance with the location of the target material of interest within that region.

9. A method according to claim 8, wherein the regions are arranged along a Z axis defining the magnetic field direction of the magnetic resonance apparatus, and wherein, within a particular region, the magnetic field gradients are controlled along an X axis and/or a Y axis, the X and Y axes being substantially orthogonal to the Z axis.

10. A method according to any of the preceding claims, wherein when the region is situated at $z=z'$ then the desired gradient G_z is determined in accordance with the conditions:-

$B_z(z')=G_z\cdot z'$ so as to position the slice correctly;

$B_z(z)\neq G_z\cdot z' \text{for} z\neq z'$ over the working volume so as to avoid aliasing; and

$\frac{\partial B_z}{\partial z}\Big|_{z=z'}\approx G_z$ to achieve the correct slice thickness;

wherein $B_z(z')$ is the B field in the z direction at the position z=z' and wherein the B_0 field is in the z direction.

11. A method according to claim 10 wherein the gradient is determined in accordance with the condition $\frac{\partial^2 B_z}{\partial x^2}=0$ so as to eliminate curvature of the region.

12. A method according to any of the preceding claims, wherein when the region is situated at $x=x'$ then the desired gradient G_x is determined in accordance with the conditions:-

$B_z(x')=G_x\cdot x'$ so as to position the slice correctly;

$B_z(x)\neq G_x\cdot x' \text{for} x\neq x'$ over the working volume so as to avoid aliasing; and

$\frac{\partial B_z}{\partial x}|_{x=x'} \approx G_x$ to achieve the correct slice thickness;

wherein $B_z(x')$ is the B field in the z direction at the position x=x' and wherein the B_0 field is in the z direction.

13. A method according to claim 12 wherein the gradient is determined in accordance with the condition $\frac{\partial^2 B_z}{\partial z^2}=0$ so as to eliminate curvature of the region.

14. A magnetic resonance apparatus comprising:-

a magnet system for generating a magnetic field in a working volume;

magnetic gradient coils for generating one or more magnetic field gradients in the working volume so as to define regions from which magnetic resonance signals are obtained from a target material; and

a controller for operating the magnetic gradient coils in use so as to apply one or more magnetic field gradients within each region, characterised in that

for each of the defined regions, the controller is further adapted in use to control the one or more magnetic field gradients in accordance with the position of the said region with respect to the gradient coils, such that the one or more magnetic field gradients have a predetermined uniformity.

15. Apparatus according to claim 14, wherein a set of at least two magnetic gradient coils are provided for producing the magnetic field gradient in a first direction and wherein the ampere-turns values of at least two of the said coils are independently controllable using the controller.

16. Apparatus according to claim 15, wherein a set of at least two magnetic gradient coils are provided for producing the magnetic field gradient in each of, a second direction, or a second and third direction respectively, wherein for each set the ampere-turns values of at least two of the said coils are independently controllable using the controller.

17. Apparatus according to any of claims 14 to 16, wherein the working volume is arranged to one side of the coils comprising the magnetic resonance apparatus, and wherein the regions are arranged in the working volume.

18. Apparatus according to claim 17, wherein the axes for the gradient coils are each arranged along a common direction.

19. Apparatus according to claim 18, wherein the gradient coils within one set are arranged coaxially.

20. Apparatus according to claim 19, wherein at least 3 Z gradient coils are provided.

21. Apparatus according to any of claims 16 to 20, when dependent upon claim 15, further comprising a controllable current supply for providing current independently to the at least two magnetic gradient coils within each coil set.